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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

ANNUAL INVESTIGATIVE REPORT FOR 1932

and

PROGRAM FOR FISCAL YEAR 1934

NORTHERN REGION
and
NORTHERN ROCKY MOUNTAIN FOREST AND RANGE
EXPERIMENT STATION

MISSOULA, MONTANA

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Investigative Program
Northern Rocky Mountain Region

May 17, 1933

REGION ONE INVESTIGATIVE COUNCIL

ANNUAL REPORT FOR 1932

and

PROGRAM FOR FISCAL YEAR 1934

For the Investigative Council

/s/ Evan W. Kelley
Chairman

Approved June 5, 1933.

/s/ Lyle F. Watts
Secretary

/s/ Evan W. Kelley
Regional Forester

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ANNUAL REPORT FOR CALENDAR YEAR 1932
AND
PROGRAM FOR FISCAL YEAR 1934

INVESTIGATIVE COUNCIL

The annual formal meeting of the Regional Investigative Council was dispensed with this year and in its place is being substituted, where necessary, small group conferences to consider specific programs by lines of work. Several factors contributed to the decision to dispense with the Annual Meeting. (1) Participation by the Station in the preparation of the Copeland Report delayed the possibility of a meeting until March. After this time the interested Regional Office personnel were engrossed in their annual allotment conferences and in plans for unemployment relief. No satisfactory date for a 3-day meeting could be found. (2) No new projects for 1934 were contemplated. Reduction in finances by all agencies placed the work on a maintenance basis with no expansion possible. (3) The need for reduced expenditures by all agencies made an Annual Meeting to hear progress reports by all agencies and for all projects seem unwise.

EXTENT OF REGIONAL RESEARCH BY ALL AGENCIES

The past year was one of retrenchment in Forest Research by all agencies. The apparent increase (See Table 1) in work by the Bureau of Entomology results from a transfer of funds from the Halsey, Nebraska, Station.

The major expansion shown for the Northern Rocky Mountain Station results from the reorganization and expansion effected July 1, 1931. This was the result in part of a transfer of forest products research from Region One to the Experiment Station, and in part of an outright increase in appropriations for the Forest Survey, Range Research, and Forest Management. The expansion became effective only on July 1, 1931, and it was impossible to fully organize for some time thereafter. Thus the greater part of F.Y. 1932 expenditures were made after January 1, 1932, rather than between July 1 and December 30, 1931. For this reason it is fairer, perhaps, to state that the F.Y. 1933 allotment was reduced from the F.Y. 1932 allotment by in excess of $5000.00.

With the two exceptions discussed above, the decrease varied from 25% for the Weather Bureau to 63% for the University of Idaho. Total expenditure by all agencies was increased from $145,080.00 for calendar year 1931 to $152,723.00 for calendar year 1932.

NUMBER OF RESEARCH PROJECTS, AND EXPENDITURES, BY LINES OF WORK
Northern Rocky Mountain Region

Calendar Year 1932
(Last half F.Y. 1932 and first half F. Y. 1933)

Line of Work	AGENCY															
	Univ. of Idaho		Blister Rust Cont.		Bureau of Entomology		Weather Bureau		Univ. of Montana		For. Serv. Region 1		N.R.M. Exp. Sta		Totals	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Art. Reforestation	2								1	42	3	150			6	192
Influences																
Management	3	2,215							5	2,075			4	15,859	12	20,149
Mensuration									2	57	1	700	3	2,652	6	3,409
Protection	2	1,951	5	28,140	9	(1) 17,000	3	3,842	3	890	7	2,525	2	18,568	31	72,916
Products	3	2,835							5	747			5	13,760	13	17,342
Grazing									4	331	21	440	1	12,308	26	13,079
Ecology																
Economics									1	475	1	1,200	(2) 2	21,968	4	23,643
Miscellaneous		855									8	2,660	(3) 2	3,095	10	6,610
TOTALS	10	7,856	5	28,140	9	17,000	3	3,842	21	4,617	41	7,675	19	88,210	108	157,340
% Inc.&Dec. from 1932		-63%		-32%		+16%		-16%		+1490%		-35%		+43%		+8.5%

(1) Increase of $2300 over last year due to transfer of Halsey, Nebraska, Station funds to this area.
(2) Forest Survey. Inventory phase, Requirement phase.
(3) Copeland Report and Public Domain Report.

MATTERS OF GENERAL INTEREST

The past year was noteworthy because of the unusual progress made in the various lines of work.

SILVICULTURE

The detailed seedling survival study, which was inaugurated by and took practically all of Haig's time, is bringing to light certain fundamental relationships between cover and seedling mortality which promise to furnish facts upon which to base the regeneration phase of silviculture. The data, if substantiated by further work, will demonstrate the extremes of surface temperature which seedlings must survive if clear cut or clean burned areas are to restock satisfactorily.

Field work for the inter-regional ponderosa pine volume table was undertaken and approximately 2/3 of the Regional data was collected. This project will form the basis for growth predictions in this type for the Forest Survey and will be of much value in management plan preparation. Preliminary examination of the data indicates a growth rate on good sites much in excess of that usually supposed.

The Station prepared a plan for, supervised, and assisted in the field work for a study of rate of growth after cutting in the larch-fir type. Approximately 3/4 of the required field work was completed. This project will provide a factual basis for marking practice in this type, will aid in management plan computations, and will give at least some basis for the growth phase of the Forest Survey in this type. The necessity for leaving ample growing stock after cutting is clearly demonstrated.

The above projects were all undertaken in addition to the regular routine program and were made possible by an unusually long field season, some cooperation on the part of the Regional Office, and the releasing of Weidman from administrative duties as Director.

FIRE RESEARCH

The measurement of fire danger projects made unusual strides as a result of the accumulation of data in past years. The use of the Duff Hygrometer and wood cylinders was expanded to one or more Stations on each of the fire forests. The fire danger meter, a device to correlate the 6 major variable factors influencing fire danger, was designed by Gisborne and put to use on all fire forests. Its value as a control on fire organization has been demonstrated.

The analysis of 12,056 fire reports from 13 fire forests was completed in its preliminary phase and a manuscript for a Departmental Bulletin has been completed. The manuscript, pending publication, will be mimeographed in limited numbers and put to field use.

The fire control planning project, built up around the determination of the proper number and best placement of men for detection and smokechasing and of the location and volume of roads, trails, and other capital investments required, was advanced much farther than was anticipated a year ago. Gratifying progress was made in correlating values at

stake, difficulties of fire suppression, rate of spread of fires and probability of fires' starting with the placement of man power and facilities. Seen area maps, based on field investigation of 1968 points, and covering more than six million acres, were made. Improvement plans, including road programs, and the preliminary fire control plans were completed for more than six million acres.

FOREST PRODUCTS

The major contribution by this section was the planning, organizing, and completion of the field work for the ponderosa pine selective logging study. Three plots, one to be clear cut, one to have only high quality material removed, and one to be treated as in Forest Service timber sale practice, were selected. The individual logs from all trees were followed from the stump to the lumber grading table. From the data collected will be determined the effect of size and class of tree, size and grade of log, and marking practice on net profits. All plots were perpetuated and by periodic remeasurements the effect of tree selection on growth and on sustained yield practice will be determined.

Another major project was the white pine logging cost study conducted in cooperation with the Ohio Match Company. This project, like the ponderosa pine study, is designed to determine the effect of size of log and tree on net profit. It is also designed to determine the relative value of timber of different age and from different sites for match block production.

Both of the above projects are so designed as to be of maximum benefit in the appraisal of the value of government timber and in the management of government timberlands.

FOREST SURVEY

Detailed plans were made for taking an inventory of all privately owned timber remaining in the Inland Empire and for a classification of the timberland by type and productivity. Field work was completed for all of Benewah and parts of two other counties. Nearly 400,000 acres of cutover land were mapped in place and the company estimates for five of the larger private timberland owners were carefully checked in the field.

RANGE MANAGEMENT

A detailed study of the proper management of short grass range type of the Northern Great Plains was started. Fourteen pastures, half of which will be used for summer and half for winter grazing, were built. Sixty head of two-year-old heifers were dedicated to the project by the Bureau of Animal Industry and were placed in the summer pastures early in July. Two pastures for each of three intensities of use were provided by varying the size of the pastures. The first year's study clearly shows the economic desirability of proper use of the range. The difference in weight gained by the cows in the overstocked pastures as compared to those in properly stocked pastures, figured at 5¢ per pound, was sufficient to

have leased the necessary additional range with a balance of $2.40 per head left over. Such information is essential to the survival of range livestock industry of the Region.

MISCELLANEOUS

The above brief statements cover only the high lights of the season's work. In addition, time and expense were contributed to the extent of $3633.00 for the Copeland Report and $519.00 for the Public Domain Report.

Fortunately, the fire season was such that practically no time of the Station personnel was required for Fire Suppression.

SELECTION OF RESEARCH AREAS

During the year detailed reports were prepared recommending the designation of the Deception Creek Experimental Forest in the white pine type on the Coeur d'Alene Forest, and of the Coram Experimental Forest in the larch-fir type on the Flathead Forest. Final action by the Washington Office is pending.

Similar reports were prepared for the Pine Creek white pine area on the Clearwater Forest and for the Trapper Creek yellow pine area on the Bitterroot Forest. The first has been held up pending an attempt to locate an area or an addition with a better distribution of age classes. The report on the Trapper Creek area was withdrawn because of a serious bark beetle infestation which promises to destroy its usefulness.

Several areas fairly satisfactory as natural areas have been located and examined. It is hoped that during the coming year definite decision on three areas can be reached and that reports recommending action can be submitted.

PROGRESS BY LINES OF WORK DURING 1932

FOREST MANAGEMENT

REPRODUCTION STUDIES

This work aims at determining how to get reproduction successfully after cutting. The methods of attack are through reproduction quadrats, seed traps, viability tests of stored seed, and a special study of early seedling mortality and survival.

Reproduction Quadrats

Last summer 1077 existing quadrats on cutover land were examined one or more times and 72 new quadrats were established. Altogether 1459 quadrat examinations were made. During the winter all compilation and computations of quadrat records since the project was started seven years ago were brought up to date.

Results of the 1932 examinations confirm indications of the preceding year that heavy mortality occurs in the first three years and that it may exceed 90 per cent of all seedlings that germinate. In 1932 the loss of one-year-old seedlings was as high as 80 per cent, that of two-year-old seedlings as high as 50 per cent, and that of three-year-old seedlings as high as 30 per cent. The 1932 losses in four, five, and six-year-old seedlings decreased greatly to a low figure of 3 per cent in the case of one group of quadrats. This magnitude of reproduction loss was an unexpected finding for the white pine type. Causes are indicated to be mainly drought and high ground-surface temperatures. An important application value is that an abundance of reproduction does not necessarily mean successful regeneration until the seedlings are over three years old, and that only a very small percentage of younger seedlings can be counted upon to survive.

Other results from the quadrats are: (1) Reproduction from seed stored in the duff can not be depended upon unless a good cone crop occurred within two years preceding cutting, which may happen about 50 per cent of the time; (2) over three quarters of the reproduction that starts in the northern part of the type is hemlock and cedar; (3) mortality of hemlock and cedar is many times greater than that of associated species and continues longer; (4) white pine reproduction is satisfactory in quantity and distribution on more than half of the 26 areas that are being sampled, and is gradually increasing on all others where there are sufficient white pine seed trees.

The 72 new quadrats were established in so-called hemlock-disposal areas. Hemlock disposal is a type of silvicultural treatment by which the defective material in climax stands is felled and broadcast-burned following logging of the sound and merchantable trees. Restocking, if it is secured naturally, must come from scattered larch seed trees which can survive the fire, and through seeding from the side. Forty-four mil-acre quadrats were installed on one 160-acre area treated in this way and 28 mil-acre quadrats on another area of about 40 acres. The purpose is to determine the rate and character of restocking following this method of cutting.

Seed Traps

Seventy-six seed traps have been in place for various periods up to six years. Twenty-six new traps were set out in 1932. Some traps are examined 6 times a year, others only once yearly; 280 trap examinations were made in 1932. The traps are located in series in old and young stands and under different conditions of cutting. Compilation of records was brought up to date this winter. This work is contributing the first concrete knowledge of time, quantity, distance and character of seed dissemination in the white pine type.

Results of five years' examinations reveal a tremendous dissemination of cedar and hemlock seed in old timber, which in one uncut stand and two timber sale cuttings amounted to 92, 93, and 96 per cent of all seed caught. The catch of white pine seed on these areas was 4, 2, and 0.2 per cent. In number, however, the average annual fall was 40650, 5400, and 4250 white pine seeds per acre. Traps in a young stand 80 years old tell a greatly different story. Here cedar and hemlock seed comprise

only 15 per cent of the catch, white pine 10 per cent, larch and Douglas fir 30 per cent each, and miscellaneous species 15 per cent. In number the average annual fall of white pine seed was 4350 per acre. As large-sized seed is mostly harvested by squirrels before the cones open, the seed traps measure only seed dissemination rather than total seed production.

Seed Storage and Viability

This work consists of two experiments in which known quantities of seed have been stored in the duff and taken up annually and germinated. Computations were brought up to date this winter. One series has run five years and the other three. Results to date for white pine seed in the first series give germination per cents of 40.9 after the first year of storage, 23.0 after the second, 0.8 after the third, 0.3 after the fourth, and 1.4 after the fifth year. In the second series germination was 7.3 per cent after one year of storage, 38.9 per cent after two years, and 0.0 per cent after three years. The results indicate rather definitely that white pine seed in the duff retains effective viability for only two years. This is a reasonably conclusive answer to the long debated stored-seed theory. Seed of six other species in these experiments gave less than one per cent germination after the first year and nothing thereafter.

Special Survival Study

This is a rather fundamental study closely controlled by instrumental measurements. The primary object is to determine the relative influence upon early seedling mortality and survival of light, temperature, soil moisture, precipitation, and character of soil surface. Three areas were located and fenced last year under full-timbered, half-cut, and clear-cut conditions. Over 150 one-square-foot quadrats were sowed to six species on duff, mineral, burnt mineral and charcoal surfaces. Some were watered and some not watered; some were trenched and others were left untrenched. Seedlings were staked as soon as they germinated. Examinations at frequent intervals throughout the summer were made to record mortality and determine its causes. Seedlings were dug up at intervals to ascertain the depth of root penetration under different conditions. Seedlings raised in pans and transplants in sealed pots were used to determine water requirements and wilting coefficients.

The following are preliminary results: (1) Total mortality of one-year white pine seedlings was 58 per cent under clear-cut, 19 per cent under half-cut, and 47 per cent under full-timbered conditions; (2) maximum surface temperatures on mineral soil ranged from 123° to 146° F. on clear-cut, from 77° to 142° (one exceptional reading of 158°) on half-cut, and 66° to 82° on uncut ground; (3) death from heat on the clear-cut area amounted to 28 per cent; (4) average maximum surface temperature during hottest period was 146° F. for duff, 134° for mineral soil, 136° for burnt mineral soil, and 136° for charcoal; (5) total white pine mortality for all quadrats was 70 per cent on duff, 38 per cent on mineral soil, and 38 per cent on burnt mineral soil; (6) by the end of July white pine roots had penetrated to 8 inches on clear-cut ground and to only 2¼ inches on full-timbered ground. By mid-summer soil moisture was critically low in the 0 to 3-inch level under all conditions and regardless of shade.

Seedlings in the open had stocky, sturdy tops capable of supporting root penetration to deeper, moister soil levels. Seedlings in full shade had weak, slender tops incapable of supporting deep root penetration, consequently the anomaly of heavy pine mortality (47 per cent) largely through drought in the full timber. The loss of shallow rooted cedar and hemlock was still greater.

Date drought? produce white pine, slender tops?

METHODS OF CUTTING

White Pine Type

There are 21 permanent plots, seven of which were given their first half-decade remeasurement last summer. Insufficient time has elapsed for these plots to yield significant results on growth of residual trees.

Ponderosa Pine Type

Three plots to investigate the possibilities of selective logging were established near Missoula as a cooperative project between Silviculture, Products, and Management and several State and private agencies. The plots were marked and logged to conform with clear-cutting, economic selection and silvicultural selection methods. The total of 18 acres in the three plots includes an aggregate of 1800 tagged trees over 4 inches in diameter. Weidman contributed by assisting in the plans and establishment, in taking the diameter and tree description data, and in marking the silvicultural selection plot. He is to be responsible for the periodic remeasurements. The logging and milling phases of the study are discussed under the Products section of this report.

MENSURATION

White Pine Type

The project comprises 29 permanent and 56 semi-permanent yield plots. Five plots were remeasured in 1932. All measurements to date for the 29 permanent plots were machine punched, sorted, and tabulated early in the year and transferred to large summary sheets this winter.

Ponderosa Pine Type

The Station is collecting its share of data for the inter-regional yield tables of even-aged ponderosa pine. Weidman and two field assistants took measurements on 33 temporary plots in western Montana in stands approximately 40, 50, 60, 90, and 120 years old. Some extensive even-aged areas were found containing surprisingly good stand conditions. The field data will be forwarded to the Pacific Northwest Experiment Station for inclusion in the inter-regional compilation. To adequately represent sites and age classes about 20 additional plots will be needed in western Montana and about 20 in eastern Montana. The 84 plots taken by Behre in northern Idaho some years ago will render but a negligible amount of field work necessary in that locality.

Larch-Fir Type

A preliminary growth study of residual stands after logging was started as a Region One administrative research project under Weidman's general supervision. Because of additional need of the data for the Forest Survey and private forestry discussions, the Station supplemented the work. Field work was accomplished by four rangers for two weeks and four field assistants for two weeks. Compilation of the data was completed at the Station this winter by men detailed from the Regional Office.

Results: Thirty plots were taken in 30-year-old private cuttings near Kalispell, Montana. Increment borings were secured on 620 trees. The average diameter growth per decade for 30 years was 0.9" for larch; 1.3" for Douglas fir; 1.7" for white fir; 1.6" for Engelmann spruce; and 0.9" for lodgepole pine. The average annual growth in volume was 132 board feet per acre for the thirty plots. Where little or no board foot volume was left standing at the time of cutting, the average annual growth was only 71 board feet per acre. Where the volume left at cutting exceeded 2000 board feet per acre, the average annual growth reached 188 board feet per acre. The figures indicate that 200 board feet or more per acre per year may be expected in timber sales or private cuttings where a reasonable volume of selected residual trees are left after cutting. The final data will be presented in the form of a preliminary yield table.

THINNING

Existing plots in the white pine type are eleven in number and range from 6 to 19 years old. This year the periodic measurements to date were machine punched, sorted, and tabulated. Work of computing volumes and transferring data to large summary sheets for permanent record was accomplished this winter.

BOTANNICAL STUDIES

Phenology: Observations in 1932 were taken at 15 stations in four major forest types. Eleven of the original 26 stations were eliminated this year due to lack of time or incapacity of the cooperators to make satisfactory records. The project is now five years old and compilation of records to date were completed this winter.

FIRE RESEARCH

Behavior Studies

The outstanding progress in fire behavior research during 1932 was the large scale, practical test of the methods of measuring forest inflammability and fire danger previously invented and evolved by this research. The wood cylinder and duff hygrometer methods of measuring the dryness, hence the inflammability, of dead branchwood and duff were used under actual field conditions at 25 stations. Eighteen of these were on ten National Forests in Region One, five were on National Forests in Region

Four, and there was one set of equipment at Yellowstone and one at Glacier National Parks. The opinion of the field men concerning the value of these methods in assisting toward better fire control is indicated by the fact that all of these stations will be continued in operation during 1933 and equipment for 18 new stations has been ordered by these forest officers.

These wood cylinders and duff hygrometer methods are intended only to measure forest inflammability which is but one factor of forest fire danger. In order to insure consideration of all the important variable factors of fire danger, a device called a Fire Danger Meter was evolved during the winter of 1931-32. This device rates the effect of each of six factors in fire danger including (1) season of the year, (2) activity of lightning and people, (3) visibility, or the distance at which small smokes can be discovered, (4) wind velocity, (5) exceptionally low relative humidity, and (6) fuel moisture and inflammability. By the integration of the effects of these six factors the Danger Meter produces a rating of fire danger both in terms of rate of spread of fire and in terms of administrative action needed to cope successfully with prevailing or probable danger.

These Meters were given a practical trial by over 100 field officers in this Region during the 1932 fire season and it was their unanimous opinion that the use of this device should be continued as an aid toward more efficient and less costly fire control. While one or two minor changes in the ratings of some of the factors have been suggested by these field men, there was not sufficient unanimity of these recommendations - and there were some contradictions - so that the Meter is to be continued in use without change during 1933.

A new wind scale to replace the notoriously inaccurate Beaufort Scale was produced in tentative form during 1932. Preliminary tests showed that each of several men were able to approximate the true wind velocity far more accurately by use of the new scale. This possibility has been taken up with the Washington office of the Weather Bureau and they approve this work. An attempt also has been started to invent a very inexpensive anemometer for use at numerous forest stations. Estimates of wind velocity are known to be almost always in error, and frequently to a serious degree. As the standard 3 or 4-cup anemometer costs about $65.00, a cheaper instrument can be used to excellent advantage even though it is not as accurate as the standard required at all official Weather Bureau Stations.

During 1932 the study of lightning storm occurrence and characteristics was continued for the eighth year. As one report covering five years was issued in 1931, no further reports are planned until the data include a full ten years.

During 1932 an analysis was completed of the fire reports for ten forests covering ten years. The records of over 12,000 fires were included in this study. The purpose was to determine those practices in fire control which can be expected to provide satisfactory forest protection at the least cost.

After summarizing the character of the fire problem in this Region, and showing the degree of success attained by past practices and facilities,

this report presents separate standards of protection for least difficult, dangerous, and critical seasons, and stresses the absolute necessity of planning all facilities and man power needed for the critical year if protection is to be successful over a long period. The speed and strength of attack needed in least difficult, dangerous, and critical seasons are given separately with the provision that costs shall be held to a minimum during least dangerous years while the more costly maxima of speed and strength of attack shall be used only when critical conditions prevail, with the consequent danger of tremendous losses. In general the most economical policy is shown to be one of increased expenditures for quick control at small size so that far less money will be spent on large fires that destroy great commercial, recreational, and other values.

A statistical analysis of fire weather data is being made in Washington at the present time. The study so far has been confined to afternoon observations taken at Priest River on the clear-cut area. The relationships of both duff and one-half inch wood cylinder moisture to air temperature (above 70° F.), relative humidity, and the number of days since .01" rain have been studied.

The work has been greatly simplified by the finding that a linear relationship exists between fuel moistures and absolute humidity in these data. This effect is obtained by substituting for relative humidity, the product of temperature times relative humidity in multiple correlations of fuel moisture and the several independent variables.

It has been found that duff and one-half inch wood sticks respond in the same way to changes in temperature and absolute humidity. The number of days since .01" of rain has no influence upon duff moisture, but has a significant effect upon wood. In both cases, absolute humidity has a greater influence upon the moisture content of fuels than either of the other independent variables.

Attack

Researches under this project as handled at this Station are in the field of "Fire Control Placement Planning." It is the purpose of this group of studies to develop methods and procedure for fire control planning and to supervise and direct the application of these methods to fire control plan preparation on the National Forests. The major features of any plan are: (1) the proper size and location of detection forces, (2) the best distribution and size of the smokechaser organization, and (3) the justifiable expense, location, and character of improvements such as roads, trails, telephone lines, and buildings.

Regardless of any arbitrary objectives, such as allowable burn by types, the fundamental basis for determining the proper intensity of fire control must be that degree which will result in the smallest total cost of prevention plus suppression plus damage. It is toward this fundamental objective that our studies are directed. Two major factors are involved in rating fire danger for any forest or parts of any forest: (1) the value of the resources to be protected, or fire damage, and (2) the likelihood that these values will be destroyed.

Values (Damage)

While no great refinement is now possible in appraising the total value of the destructible resources, every fire plan must weigh such information on values as is available. This Station, therefore, is proceeding on the theory that each service of the land protected, subject to loss by fire, must be rated. For the owner interested only in direct and immediate revenues, the damage which will result from losses in different areas is relatively simple. For the public forest administrator, not only immediate revenues, but numerous other services of the forest must be considered. To say that we have satisfactorily determined the probable damage to wood products, recreation, wild life, water, soil, and climatic influences and to the social benefits attached to these values would be gross overstatement. All of the available data have been used to allocate the forested lands into six classes of damageable value expressed in dollars per acre.

Likelihood of Loss

The likelihood that the assigned values for a given area will be destroyed by fire depends upon (1) the probability that fires will start, or occurrence, (2) the rate of spread of fires, and (3) the difficulties of fire suppression, or rate of held line construction.

Fortunately the National Forest fire records show the location of all known fires by causes. From a 10-year summary map the number of fires per thousand acres was approximated, giving due allowance for changing conditions of fuel and causes. This provides a usable basis for estimating future fire occurrences for specific areas.

An analysis of the records of 12,056 fires has established a reliable basis for assigning a rate of spread of fires under various conditions of topography, fuels, and weather. For the purpose of planning, only four classes, according to average rate of perimeter increase per hour of burning, are used. These are, extreme 14, high 10, medium 8, and low 6 chains per hour. In actual planning work these rates of spread ratings are applied to all areas as taken from maps which are based on intensive field work.

To determine rates of held line construction per man hour estimates were obtained from approximately 125 qualified men. These estimates covered a variety of specified fuel conditions. Efficient action by men of the smokechaser type was assumed and mop-up work was excluded from consideration. The range of these estimates was divided into three equal parts and the mid-point of each class was found to be: high 1.5, medium 4.1, and low 6.7 chains per man hour. Here again the basis for applying these ratings is intensive maps showing resistance to control for all of the area included in the plan. The cost per man hour of labor on the fire line as determined from the statistical fire analysis and from activity cost records was found to be $4.00.

Relative Need for Funds as Between Areas

Proper rating of areas according to relative need for fire control funds is dependent on the proper combination of the above factors. The following tabulations illustrate the method actually followed in rating areas on the basis of relative danger.

EXPENSE PER HOUR OF BURNING

At $4.00 per Man Hour		Rate of Spread: Extreme	High	Medium	Low
		Expense per hour of Burning			
Resistance to Control	High	37.4	26.7	21.4	16.0
" " "	Med	13.7	9.8	7.8	5.9
" " "	Low	8.4	6.0	4.8	3.6

DAMAGE PER HOUR OF BURNING

St. Joe Forest Data		Rate of Spread: Extreme	High	Medium	Low
		Damage per hour of Burning			
°Damage Value per Acre	$24.50	68.6	34.3	22.5	12.7
" " " "	10.00	28.0	14.0	9.2	5.2
" " " "	6.50	18.2	9.1	6.0	3.4
" " " "	3.00	8.4	4.2	2.8	1.6
" " " "	1.75	4.9	2.4	1.6	0.9
" " " "	1.00	2.8	1.4	0.9	0.5

°The rate of damage per hour of burning was obtained by taking one fourth of the acreage accumulated in four hours of burning. This was multiplied by the damage value per acre. This placed all areas on the same basis, the average expense and damage per hour for four hours of burning during bad mid-day weather.

EXPENSE PLUS DAMAGE PER HOUR OF BURNING
Using a Damage Valuation of $10.00 per Acre

St. Joe Forest Data		Rate of Spread: Extreme	High	Medium	Low
		Expense plus Damage per Hour			
Resistance to Control	High	65	41	31	21
" " "	Med	42	24	17	11
" " "	Low	36	20	14	9

The above tabulation illustrates the method used in calculating the cost per individual fire for each hour it is permitted to burn provided it is ultimately to be controlled by direct action. These data multiplied by the average number of fires per unit of area give a direct expression of the relative probability of loss (we have used the term danger-acres to express this combination), and a foundation upon which to base the allocation of available fire control funds. Expressed as a formula this reads: (Rate of E + D) x Occurrence = Relative Danger.

It does not give a measure of the total expense which can be justified.

Justifiable Expenditure

Each of the essential services, detection, smokechasing, and reinforcement must perform its function within certain specified time limits if the lowest total cost, including damage, is to be attained. Detection

points must be so located and of sufficient number to insure the detection of all fires before they have had time to exceed a specified size. Smoke-chaser locations must be such that all of the area can be reached within the time allowed. Likewise roads, landing fields, or other transportation facilities must be such as to enable a crew of given size to reach the area from available population centers within a certain travel time. These time limits have been based on rate of spread of fires and resistance to control under different fuel conditions and on the fact that, normally, cheap control can be had only by corralling the fire by noon of the day following discovery. Burning conditions, normally, are such after midday that little progress is made in overtaking the rate of perimeter increase.

The following formula has the dual use of determining time standards in planning and of determining required strength of attack in fire suppression where travel time is known.

$$t = C \frac{(4\ wn - p)}{(4\ wn + p)} - B$$

t = Allowable travel time in hours
B = Report getaway, 0.25 hour used
C = Hours, discovery until spread stopped.

w = 1 man rate of work (ch. per hr.) constructing held fire line. "w" was reduced proportional to number of men above 3 in crew based on w per man of 10 man crews = .67 w per man with 1 man.
p = Average rate of perimeter increase in ch. per hr.

STANDARDS FOR PLANNING SMOKECHASER TRAVEL COVERAGE

Standards apply during average worst weather danger.		Rate of Spread			
		Extreme	High	Medium	Low
		Travel Time in Hours			
Resistance to Control	High	1.00?	1.00°	1.00°	1.50
" " "	Med	1.00?	1.00	1.75	3.00
" " "	Low	1.00?	1.75	2.50	3.50

? Requires crew action. Number of men shown by formula.
° Requires 3 men when burning conditions are critical.
Remainder requires 2 men when burning conditions are critical.

The travel time allowed second line defense is 8.5 hours from any man-power base of 100 men. This time is designed to deliver men at the fire line by 6:00 a.m. after escape of any fire.

Standards were specified for three degrees of weather danger, minimum, average, and worst.

Progress in Applying Principles

The working arrangements through which placement planning has been carried out involve the Experiment Station, in charge of the project, and the Regional Offices of Operation, Engineering, and Forest Management.

Seen Area Mapping was completed for 1968 potential points covering 6,717,500 acres.

On the other hand, an economic selection cutting, though it lowers the volume removed, generally raises the average size of the logs brought to the mill. This is true because the grade 4 logs are usually the smaller top logs, as is indicated by the overrun of 32%. The larger the average size of logs, the lower the direct costs of logging and milling. It is obvious that any cutting system which will reduce the volume of grade 4 logs is economically desirable.

How much the purely economic consideration need to be sacrificed for silviculture needs further study.

Preliminary analysis of data collected on the Ohio Match Company selective logging study has indicated a difference in conversion value of western white pine logs when converted into match plank and to commercial lumber. The timber studied was worth from $2.00 to $4.00 more per M lumber tally when graded and priced on a commercial lumber basis.

WOODS AND MILL UTILIZATION

Depreciation Studies

While no special utilization project was planned or conducted during the past year, data on utilization was secured in connection with logging and milling studies. As a part of our selective logging studies in the ponderosa pine type, data were secured on the effect of fire scars on the conversion value of trees and logs. As an example, the analysis of the yield of lumber produced from a fire-scarred ponderosa pine tree, 490 years old and 31 inches in d.b.h., shows some interesting and practicable information.

LUMBER YIELD BY GRADES

Log Position	Select	1 & 2 Shop	3 Shop & Inch Shop	Common				Total
				1 & 2	3	4	5	
	%	%	%	%	%	%	%	%
Butt	16	0	3	0	12	44	25	100
2	59	0	1	0	40	0	0	100
3	13	13	9	0	26	39	0	100
T	0	0	0	0	10	90	0	100

It has been ascertained for sound overmature trees that the butt cut is consistently equal and usually better in quality than the second log in the tree. The yield of select for the butt cut figures, as indicated by the above, was only 16% compared to 59% for the second log in the tree. This difference in production of high quality lumber no doubt is due entirely to the fire scar. An examination of the lumber produced from logs 3 and 4, which respectively produced 39% and 90% of number 4 common lumber, showed considerable rot. This condition is quite common in trees that are badly fire scarred and can no doubt be indirectly attributed to the fire damage.

A computation of the selling value of the lumber produced from this tree shows the butt log to have a lumber value (green chain grade based on 1928 average prices) of $6.21, compared to $16.73 for the second log. Thus

the net loss to the butt log from fire scar was $10.52, or the lumber produced from the butt cut was worth $20.70 per thousand lumber tally compared to $41.82 for the second cut - a startling loss for which the fire scar was directly responsible. Such a log as this can not be profitably converted into lumber even under normal market conditions. Under proper utilization methods this tree would have been long-butted at 8 feet above the stump cut and two 16-foot logs utilized above that point. The first log would have then yielded as good a grade of lumber as the second log actually did, while the next log would have also produced a good yield of select. Thus the number 5 common lumber could have been entirely eliminated, as well as more than half of the yield of number 4 common.

STATISTICS ON FOREST PRODUCTS

Current data are obtained on the amounts produced, production costs and selling values of the forest products cut and manufactured within the region. The selling value of lumber by species and grades for the several districts compiled by this section is used in figuring the sale value of government-owned timber by the Forest Service and Indian Service in Washington, Oregon, Idaho, and Montana. Detailed lumber manufacturing costs are collected annually from the larger band mills of the region. These data, as well as the selling value of lumber, are absolutely necessary in figuring the sale value of government timber. The figures on the amounts of forest products produced within the region, collected in cooperation with the Bureau of the Census, are becoming more and more useful in depicting trends, figuring drain, and in planning any forest management policy for the Region. Statistical information collected and compiled by this Section was used extensively in such reports as the Extensive Revision and Copeland Resolution.

The productive results of this project may best be illustrated by the following statements:

1. Compilation of regional summaries and a preliminary statement covering the Idaho-Montana census of lumber and timber products for 1931, was completed in August, 1932. As compared with the 1929 cut, production of sawed lumber in 1931 for the two states declined 53.5 per cent. From 1930 to 1931 the decline amounted to 42.1 per cent.

2. Returns received from Idaho and Montana mills in connection with the 1932 lumber census covering at least 80 per cent of the total production in these states indicate that the 1932 cut was nearly 50 per cent less than that of 1931.

3. From the data already available it is evident that the aggregate cut of the two states for 1932 did not exceed 375 million board feet. The estimated cut of about 95 million feet for Montana will be the lowest recorded since 1890. An indicated cut of 280 million for Idaho would be the lowest in that state since 1905.

4. The census statistics collected by this Station provide basic information used in reports called for by Congress and are necessary for the administration of the national forests.

The following tabulation was built up from statistics collected and compiled by the Section of Products:

Year	Production Costs Per M ($) Lbr. Tally Basis: Lumber Manufacture	Logging	Total	Average Stumpage Value Per M	Millrun Wholesale Value Per M	Margin for Interest, Profit and Risk Per M
			Idaho White Pine Operators			
1923	12.63	13.86	26.49	6.27	48.85	+ 16.09
1924	12.59				39.20	
1925	11.62				37.37	
1926	11.81				37.77	
1927	12.00	12.45	24.45	5.67	35.86	+ 5.74
1928	11.75				31.09	
1929	11.49				34.33	
1930	13.04				33.56	
1931	12.85				27.56	
1932	12.45	11.64	24.09	4.67	22.87	- 5.89
			Ponderosa Pine Operators			
1923	11.65	10.94	22.59	3.39	34.88	+ 8.90
1924	11.25				28.16	
1925	10.76				28.02	
1926	11.34				26.33	
1927	10.86	11.31	22.17	2.44	25.17	+ 0.56
1928	10.31				24.51	
1929	10.18				26.17	
1930	11.36				21.64	
1931	11.35				18.25	
1932	11.72	8.32	20.04	2.24	16.02	- 6.26

It is interesting to note the trend in production costs and selling value over this relatively short period of ten years. In 1923 the margin for interest, profit and risk for the average white pine operator was $16.09 per M. In 1927 this margin had been reduced to $5.74 per M. Last year the average white pine operator was fortunate if he lost only $5.89 per M. The case of the average ponderosa pine operator is even more gloomy. Unable to reduce production costs in proportion to the rapid drop in selling value, the ponderosa pine operator has seen the margin for interest, profit and risk drop from $8.90 per M in 1923 to a loss of $6.26 per M in 1932. In the case of manufacturing costs, overhead charges, such as general expense, taxes and depreciation, have mounted rapidly due to curtailed production and sales. Though lower wages in the past two years have cut down the direct costs of operation, they have been insufficient to overcome the increased indirect costs.

FOREST SURVEY - REQUIREMENTS

In the timber requirements phase of the Forest Survey it is necessary to estimate, as accurately as possible, present and future forest requirements. Lumber is the chief forest product, and in getting this study under way the use of lumber for urban building construction is being studied first. Work on urban construction needs was started in August, 1932. However, during the last five months of the calendar year 1932 only 25 per cent of Whitney's time was spent on this study.

As very few cities within the Region are large enough to be included among those for which the Bureau of Labor statistics has published summaries of residential and other use classifications, data on volume and types of construction have been obtained from fifteen Montana and Idaho cities by correspondence. Missoula was selected as the first sample plot. Information from all building permits issued in Missoula for the years 1914, 1919, 1924, 1929, 1931, and 1932 has been transferred to cards and partly analyzed. Bills of material for use in setting up conversion factors for dwellings have been obtained. The completion of conversion factors, an investigation of obsolescence and final analysis of the data collected at Missoula will probably require about two months. As soon as sampling is completed at Missoula it is planned to cover Spokane. It is estimated that the collection of detailed requirements data for Spokane will be at least partly completed during the present fiscal year.

WOOD PRESERVATION

Cost data and other information resulting from the Regional wood-preserving studies has been widely used in treating telephone poles, fence posts and stubs required in constructing and maintaining Forest Service improvements. Other Federal agencies as well as some commercial companies and private individuals make use of basic information obtained from these studies. Requests for wood preservation data supplied by this Station during the past year included inquiries from several companies using or producing timber products on a large scale. For example, The Montana Power Company, Great Falls, Montana; The Bunker Hill & Sullivan Mining and Concentrating Company, Kellogg, Idaho; The Tamarack & Custer Consolidated Mining Company, Wallace, Idaho; and Potlatch Forests Incorporated, Lewiston, Idaho.

FOREST SURVEY

GENERAL

The work of the economic forest survey has gone forward as rapidly as the limited funds available have permitted. During the past year a great deal of preparatory work has been done. Included in the preparatory work was, first, the choice of methods. Two methods of procedure were possible in this Region: (1) stripping the country, and (2) compilation of available information, filling in the missing data by field work. After a survey of the amount and kind of information available, and consideration of the factors involved, the compilation method was decided upon as giving the largest return for the money expended.

Work plans were drawn up covering the Inventory phase of the survey. In drawing up the work plans a number of specific items of work were accomplished:

a. The available site data was worked into height-over-age curves for white pine, larch, Douglas fir, and lodgepole pine. Ponderosa pine curves were obtained from Region 6.

b. Type definitions with size and age class divisions within each type were worked out.

c. Methods and forms for collection of cruise information were built up.

d. Methods and standards for field mapping were worked out and set up in the plan.

e. The Regional volume tables for all species were checked by Girard and new tables built up for ponderosa pine, larch and Douglas fir.

f. Methods and standards for adjustment cruising were decided on by Girard and the cruisers. These were set up in a separate plan for this part of the work.

g. The work plans have been checked by actual work during the past season. Details have been worked out and irregularities corrected. The work of the past season has therefore resulted in a clear picture of the job ahead, and has laid the foundation for greatly expanded accomplishment with each dollar spent as soon as the necessary funds are available for an expanded field organization.

COLLECTION OF INFORMATION

During the season, information on 400,000 acres of timberland was secured from fourteen of the large owners of timberland in northern Idaho. With the exception of 20,000 acres in Shoshone, the collection of Benewah, Kootenai, and Shoshone Counties is complete.

MAPPING

The work of mapping in place, to supply the information not available through collection, is confined to cutover and burned-over lands, and small isolated tracts of timber in small ownership. This phase of the work was most severely limited by the lack of funds last season. Three men spent a total of 12 man months on mapping. Three hundred ninety thousand acres were covered, or an average of 32,500 acres per man month. Of the total, 30,000 acres were mapped in Pend Oreille County in cooperation with the Regional Office of Lands, 30,000 acres in Kootenai County after bad weather conditions had shut down the work in the white pine type, and 340,000 acres in Benewah County, where typing conditions are as difficult as any which will be encountered. Types are badly mixed and recent cutover areas generally contain a residual stand of mixed timber of merchantable volume, which must be cruised as well as mapped. The office work of compiling estimates and type data for the area mapped last season has been done.

Preparatory work for next season will be finished in time for a May 1 start in the field.

ADJUSTMENT CRUISING

During the field season of 1932, two check cruisers spent a total of eight months on adjustment cruising. A total of 320 forties were check cruised by a 10 per cent estimate. The bulk of the forties cruised, 280 out of 320, were in Benewah County, Idaho. The remaining forties were in Shoshone County. Logging Engineer J. Girard checked the two cruisers carefully once during the field season.

On the basis of last summer's cruising, dependable correction factors have been determined for the existing estimates of five of the principal timber owners in north Idaho, and estimates in the St. Joe and St. Maries river drainages have been adjusted.

Last season's check cruising has shown that the private timber cruisers within the north Idaho white pine region employ practically the same mechanics, standards, and cull factors in cruising Idaho white and ponderosa pine as do the Survey cruisers. The correction factor for Idaho white pine averaged 1.11, based on 61,785 million feet checked by the Survey cruisers. The correction factor used varies between 1.05 and 1.30 for the individual companies. There was a difference of only a few thousand feet between the Survey cruises and the company estimates on the 26 million feet of ponderosa pine checked during the summer. The correction factor averaged 1.01.

It is interesting to note that with the exceptions of larch, lodgepole pine, Engelmann spruce and cedar poles, the company cruisers have invariably obtained a larger volume of the minor species than have the Survey cruisers. This is particularly true in regard to cedar, white fir, hemlock and Douglas fir. The difference in white fir-cedar and hemlock is due, no doubt, in part to the large amount of defect which occurs in these species. There is, however, an additional reason why the private cedar sawlog estimates overrun the Survey's cruises. Cedar poles have a value far beyond that of cedar sawlogs, so wherever possible the Survey cruisers have estimated the cedar tree on the basis of its pole producing capacity. This is also one of the reasons why the Survey cruises contain more cedar poles than the private estimates. Many of the minor species are short lived, and for this reason old private estimates will show an excess in volume that a later cruise will not have. This is particularly true of Douglas fir.

RANGE INVESTIGATION

GENERAL STATEMENT

Widespread failures that followed misdirected dry farming attempts in the Northern Great Plains Region during the past 20 years have at last convinced agricultural authorities, bankers, and others conversant with the situation that a fresh start must be made which will avoid the socio-economic maladjustments resulting from ill advised or destructive exploitation of natural soil and forage resources. A more stable program of land utilization there involves questions of correct range utilization, what constitutes a minimum economic ranch unit, the proper balance between range and harvested crops and the pressing immediate problem of cheaper range livestock production. Data that will be useful in such a program are beginning to accumulate from range research work initiated last year at Miles City. Sound land use promises to pay dividends.

Forty cows from lightly stocked experimental summer pastures gained enough more weight, valued at five cents per pound, than the average of twenty similar cows on heavily grazed experimental pastures, to pay for the difference in range allowance and still leave $2.40 per head margin in favor of those with ample range. These 40 cows wintered on lightly grazed ranges with 430 pounds of alfalfa hay to supplement native forage and came

through the winter in much better condition than those from heavily grazed ranges given slightly more feed and care. The comparative effects of different intensity of utilization can not be fully measured until data on calf crop, rate of depreciation, final production costs and range stability become available as the experiment proceeds.

Three years of drought that culminated in 1931 with the driest year ever recorded at Miles City resulted in premature forced shipments of up to 60% of half-starved range livestock at ruinous prices and reduced forage production up to 65% from severely overgrazed ranges. In contrast, the conservatively grazed U.S.R.L. Experiment Station ranges not only maintained the usual quota, but carried an increased number through the last winter of drought. Forage from these station ranges suffered very much less from the drought and produced a great deal more feed of a better quality in both 1931 and 1932 than did overgrazed ranges.

Preliminary reseeding tests with crested wheat grass under varying soil, use, and competitive conditions indicate its great possibilities for rehabilitation of abandoned plowed land even on alkali soil. The proper place in range management practice of this and other promising species remains to be worked out by systematic investigations.

CARRYING CAPACITY AND RANGE UTILIZATION

During the 1932 season two wells were drilled; windmills and tanks were installed; 14 pastures, requiring about 19 miles of fence, were enclosed; and corrals, chutes and a small cabin were built. Vegetative records were initiated and sixty head of 2-year-old heifers were started on carrying capacity tests in July. This project has been on a going basis since that time, although a considerable number of plots must be fenced and a few fence changes made this spring before the set-up will be completed.

Data on Vegetation

Initial charting of 18 quadrats were made. Grama grass even on moderately grazed station ranges suffered considerably from the three years' drought of 1929-30-31. The study did not begin soon enough to determine whether the death of up to 37% of grama grass clumps on the quadrats in the grama type was due entirely to the record dry season of 1931 or to cumulative effects of three years of drought. Most of the dead grama grass clumps apparently succumbed during 1931 rather than earlier. No evidence of loss during 1932 could be found. Loss in density on station ranges during the drought also occurred in sagebrush, three-awn grasses, and other species to a lesser extent so far as could be determined by both quadrats and careful observations.

On ranges heavily overgrazed for years a density reduction for grama grass up to 65% was observed. Annuals low in forage value and in volume production such as plantain, fescue, hordium, have taken up some of the space formerly occupied by grama and other valuable grasses, but carrying capacity is greatly reduced.

Measurements and close observations show a substantial reduction in height growth and vigor of numerous forage plants on heavily overgrazed as compared to moderately grazed ranges. On April 30, for instance, height growth of Agropyron smithii averaged 12% less and nigger wool,

Carex spp., 14% less on overgrazed outside range as compared to moderately grazed range just inside the Station fence. On June 11, grama grass seed stalks on large areas of abused range on Sunday Creek averaged less than 6" high as compared to an average of 10½" on similar but moderately grazed ranges at the Station. One striking contrast noted on Sunday Creek was seed stalks of Stipa comata averaging 15" to 20" high when growing in protection of clumps of thick prickly pear, while those growing a few feet away without such protection averaged 11" high.

The attached chart shows the relation of the 1932 weather to normal. (See page 25.)

Carrying capacity tests were started with six summer and six winter pastures designed to give about 25% overgrazing on one pair, correct stocking on one pair, and about 25% understocking on another pair. Ten two-year-old Hereford heifers, eligible to registry and carefully selected for uniformity, and one registered yearling bull were weighed and placed in each of the six summer pastures on July 14. Bulls were removed on August 25 and the cows were changed to winter pastures on December 1. The estimated grazing use that occurred on these experimental summer pastures prior to completion of the fences on July 12 is included in the following summary for the season up until December 1.

Summer Pastures - 1932

Pasture Description	Size (Acres)	Cow Months
Overgrazed Pasture A	104.5	54.4
Overgrazed Pasture E	101.2	52.1
Normally grazed P. C	133.1	51.1
Normally grazed P. D	133.1	51.1
Undergrazed P. B	168.1	52.8
Undergrazed P. F	158.9	58.1

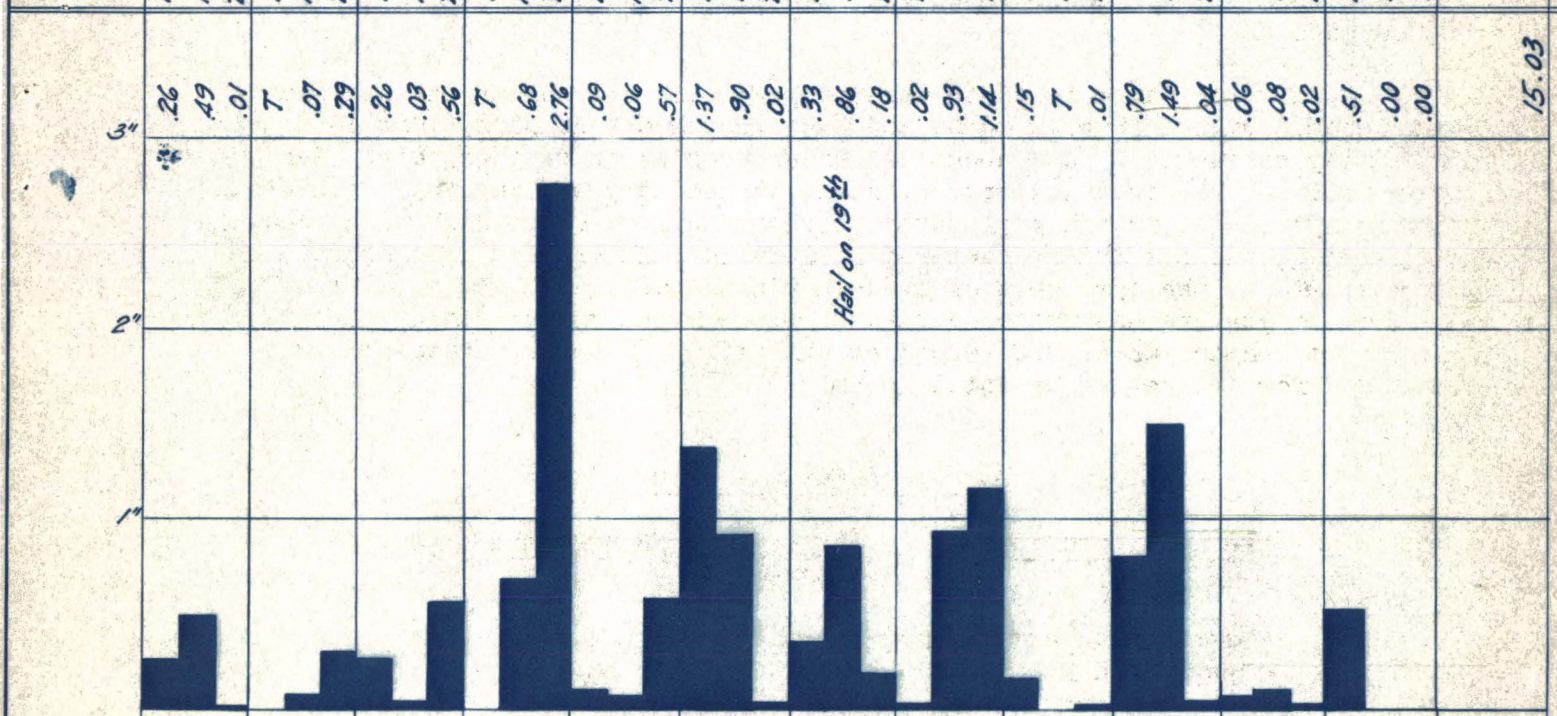
The summer pastures' set-up could not be completed early enough to allow the full six-months period of use planned. Any conclusions must be drawn with this limited use in mind. A recheck of the 1924 grazing survey data, a utilization survey at the close of the use period, and a study of weights all combined to indicate clearly the need for slight enlargement of pastures A and F and a reduction in size of pasture E to obtain the degree of use with the number of cattle per pasture during six months as originally planned. These changes will be made early in 1933.

Utilization of pasture A on December 1 had reached or slightly exceeded the point that is usually considered complete under good range practice, although there was little or no evidence of overgrazing damage. Weight losses at an accelerated rate would doubtless have resulted from any heavier utilization of this pasture. Estimated utilization on the remaining five summer pastures ranged from 55 to 75 per cent. This is a greater margin of safety than is usually considered necessary or financially justified. Any of these five pastures might have been utilized at least 15 per cent heavier than was actually done and still left a substantial amount of old feed for future insurance.

SUMMARY OF U.S.W.B. RECORDS FOR MILES CITY 1932

A. PRECIPITATION BY 10 DAY PERIODS

	JAN.			FEB.			MAR.			APRIL			MAY			JUNE			JULY			AUG.			SEPT.			OCT.			NOV.			DEC.			TOTAL
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	YEAR
	.26	.49	.01	T	.07	.29	.26	.03	.56	T	.68	2.76	.09	.06	.57	1.37	.90	.02	.33	.86	.18	.02	.93	1.14	.15	T	.01	.79	1.49	.04	.06	.08	.02	.51	.00	.00	15.03
Total P.	0.76			.36			.85			3.44			.72			2.29			1.37			2.09			.16			2.32			.16			.51			15.03
Norm. P.	0.66			0.51			.86			1.12			2.24			2.66			1.54			1.08			1.04			0.90			0.57			0.63			13.79
Depart.	+.10			-.15			-.01			+2.32			-1.52			- 37			-.17			+1.01			-.88			+1.42			- 41			-.12			+1.24



B. AVERAGE HOURLY WIND VELOCITY BY MONTHS

JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
5.2	5.2	6.8	8.1	6.8	5.8	6.3	6.7	5.4	6.8	6.4	5.7

C. TEMPERATURES (First Figure Date, Second the Max. or Min. for Month)

	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Max.	11/48°	27/71°	31/62°	14/81°	13/91°	29/98°	17/103°	9/100°	8/97°	1/80°	24/60°	2/56°
Min.	14/-20°	1/-12°	10/-15°	26/26°	1/34°	1/48°	7/49°	31/46°	22/34°	20/13°	15/-3°	9/-26°
Depart	Warmer	Warmer	Colder	Warmer	Warmer	Warmer	Warmer	Warmer	Colder	Colder	Warmer	Colder
	+ 0.7°	+ 6.4°	-3.0°	+4.7°	+2.6°	+2.4°	+ 2.7°	+ 1.5°	- 1.2°	-4.5°	+3.6°	-4.0°

Data on Stock

Weight data for the cows on both summer and winter pastures are shown graphically on page 27. Steady shrinkage in weight through December and January demanded the use of supplemental feed at least for cows from small pastures beginning January 30. Baled alfalfa hay was fed to all six lots at the rate of approximately 20 pounds per head per day for sixteen days and then reduced to an average of 10 pounds per head. Feeding was discontinued on February 26 with the breaking up of the snow blanket. During this 28-day period cows from overgrazed pastures A and T had an average of 430 or approximately 13 pounds per day. Cows from all except the small pastures would probably have wintered without any supplemental feed, but it seemed preferable to feed all lots uniformly.

Some of the high lights from weight data are:

1. A flattening out of the rate of gain for all pastures occurred during the period of drying up of the forage and the troublesome fly season, particularly in August. This flattening out is particularly striking when compared with the known average gain of 163 pounds per animal on these same heifers on comparable range during the 34-day period immediately preceding the start of this experiment on July 14.

2. The rate of gain on all pastures save A and F increased sharply again during September and early October. Weights of all lots reached the maximum in late September or early October.

3. All lots lost weight during the unusually stormy month of October.

4. Weight gains occurred in all pastures except A and F during the relatively mild November. (Probable reasons for the out-of-line weight figures from pastures E and F, and the consistently good gains from pastures C and D sill be discussed below.)

5. A fairly steep decline in weights through December and January was followed by a sharp upturn coincident with use of supplemental feed averaging 13 pounds of alfalfa per day during February.

In order to better segregate the effects of intensity of use, the lower graph on page 27 was made based on the average weight of 20 animals for two pastures combined, for each intensity which shows:

1. "Properly grazed" pastures gave consistently better cattle weights than either the "overgrazed" or "undergrazed" pastures.

2. "Overgrazed" pastures gave consistently poorer weights than any of the 4 larger pastures, except during the first month when the difference was too slight to be significant.

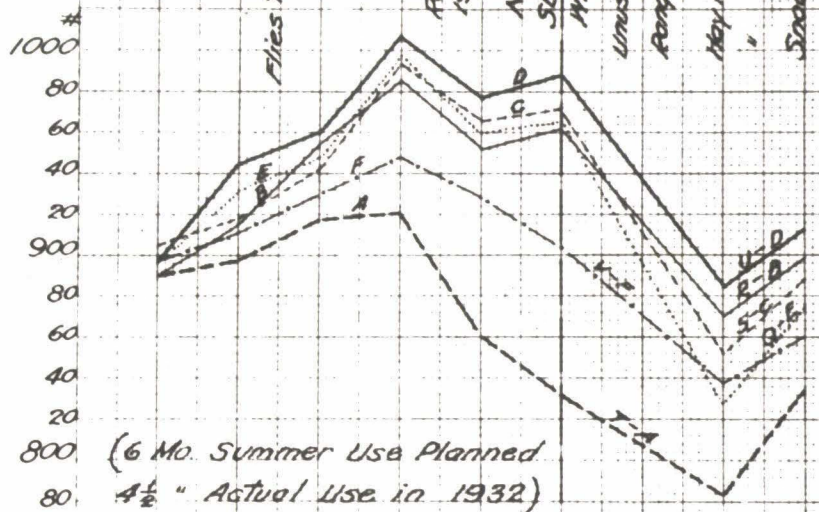
3. A decided flattening of the rate of gain occurred for pastures A and E in comparison with more lightly grazed pastures before the end of the second month with two thirds of the use period yet to come.

4. Ranges on which grama grass predominates gave better gains than those on which bluestem wheat grass predominates.

Northern Rocky Mountain Experiment Station

RANGE CARRYING CAPACITY & UTILIZATION

AVERAGE WT. 10-2 YR. OLD COWS PER PASTURE



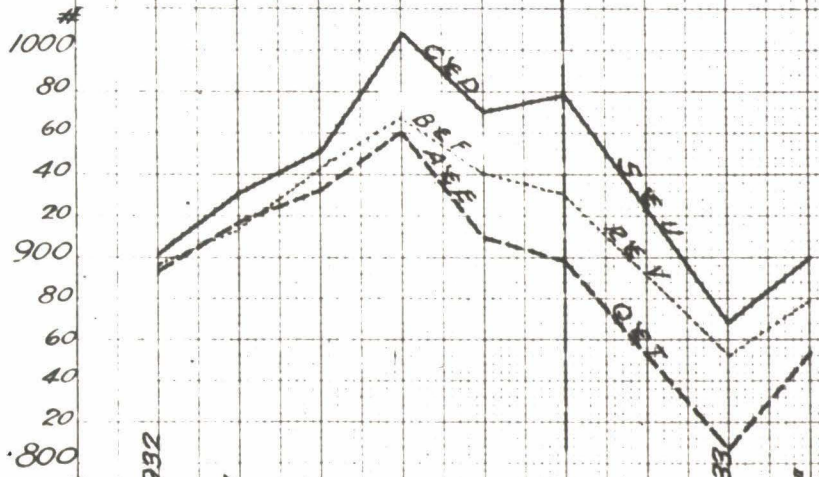
(6 Mo. Summer Use Planned
4½ " Actual Use in 1932)

LEGEND

Summer Pastures A & F - Overgrazed
" " B & F Undergrazed
" " C & D Properly Grazed
Winter " Q & T Overgrazed
" " R & V Undergrazed
" " S & U Properly Grazed

AVE. WT. 20-2 YR. OLD COWS FOR EACH GRAZING INTENSITY

Weights



JULY 14 1932
AUG. 11 "
SEPT. 8 "
OCT. 6 "
NOV. 3 "
DEC. 1 "
JAN. 30 1933
MAR. 2 "

3-26-33 LCM

H. W. Webb, Sta. J, New York, N. Y.

The late start of the test precluded use of any of the pastures to the full extent planned. As a result even pastures A, E, Q, and T have not yet been clearly overgrazed, while all others were used substantially below the intensity planned. The proposed reduction in size of pasture E and the increase for A and F for reasons already mentioned should tend to improve future weight concordance between pastures to be grazed to the same intensity.

Obviously any attempt to draw far reaching conclusions at this early stage of the study would be risky and unwarranted. Some tentative conclusions, however, may be briefly listed:

1. Two-year-old cows suffered weight penalties from feed shortage long before damage to the range from overgrazing occurred.

2. The four larger summer pastures have an average of 14.78 acres, and the two smaller pastures average 10.28 acres per head. The average gain in weights on December 1 for all cows from the former, valued at 5 cents per pound, would be $2.86 per head more than for the gains made by the cows from the smaller pastures. This additional $2.86 per head would be sufficient to lease the 4.5 additional acres per head at 10 cents per acre (a high lease price) and still leave at least $2.40 per head in favor of an allowance of range feed equal to the average for the 4 larger pastures.

3. Any effect of overgrazing on calf crop, breeding efficiency, rate of depreciation on cows and on the range remains for future determination.

4. Cows from the 4 larger pastures with plenty of grass at all times came through the winter in very satisfactory, thrifty condition with the addition of 430 pounds of supplemental alfalfa hay feed, while the average minimum allowance for eastern Montana from heavily grazed ranges is at least 1000 pounds. At $8.00 per ton this additional winter feed would amount to $4.56 per head. Conservative grazing and a proper balance between range and harvested feeds thus promises a substantial reduction in the cost of producing range cattle on both summer and winter range.

ARTIFICIAL RANGE RESEEDING

Plowed fields of eastern Montana that have been abandoned 10 to 15 years usually support less than 35 per cent as much as the original stand of forage, and where wind or water erosion has been active the production may be as low as 15 per cent or even less. The need for a study of ways and means of stopping the waste of the soil resources can not fail to impress even though there may be no need for greater total livestock production. Artificial reseeding of such lands has not yet been recognized as a station sub-project, but some incidental ground work, largely of a demonstration character, was done in 1932 with crested wheat grass. One field of 6 acres and 8 small plots was planted under varying cultural, soil, and use conditions, both with and without competition.

Results to date may be briefly summarized:

Crested wheat grass has demonstrated ability to establish itself and grow through one season of approximately normal weather conditions and on varying soils including strongly alkaline soil, and under heavy grazing and

trampling during early stages of growth. Some few plants persisted through the first summer under fairly severe competition with established native forage plants. Up to 7½ per cent of seeds produced the first year have germinated. This species responded to favorable moisture conditions by green growth both through the season and late in the fall more promptly than native forage plants. This habit may prove of great value in range practice.

Continuation with this and possibly other promising species incidental to other work is planned until Station resources will permit placing the work on a project basis to determine the proper place of this and other species in range economy of the region.

PLANS FOR FISCAL YEAR 1934

Station plans for Fiscal Year 1934 are so greatly influenced by the unsettled features of the Emergency Conservation Work program that any discussion at present may or may not have value. The following statements are based on the assumption that no assistance through Emergency Conservation Work will be received and that no allotment cuts beyond the 8⅓ per cent reduction made in the 1934 appropriation will be necessary.

FOREST MANAGEMENT

No new projects or sub-projects are contemplated for this year. We shall devote all time thus made available to the preparation of several reports on projects that are now sufficiently advanced for worth-while publications.

REPRODUCTION STUDIES

As in the past, reproduction studies will be confined largely to the white pine type. No new installations or expansions of this sub-project are anticipated. The work consists of regular annual examinations of 1139 existing reproduction quadrats, recording the cone crop on tagged trees, the collection of seed from seed traps, and the testing of viability of seed stored in the duff. The value of this project depends upon an uninterrupted annual record of seed production, germination, mortality, and survival, and of the factors which cause failure or success in the establishment of reproduction.

The intensive study of seedling survival started by Haig last year will be repeated. It is hoped that this year's data will be sufficiently conclusive to make possible the completion of the project, thus making it possible to undertake other urgent work.

METHODS OF CUTTING

Tagged trees on eight plots in the white pine type are scheduled for half-decade remeasurement. A simple series of reproduction quadrats will be installed in the three selective logging plots established in ponderosa pine last fall. Next winter we plan to analyze the machine tabulated data on white pine cutover area studies and prepare a report on the project.

MENSURATION

Twelve permanent yield plots in the white pine type are due for half-decade remeasurement. Approximately forty small temporary plots will be located and measured to complete the collection of data started last fall for inter-regional ponderosa pine yield tables. Supervision will be given to the administrative research project of ascertaining growth of larch-fir residual stands after logging if the Regional Forester decides to continue this study.

THINNING

No field work is contemplated. The material now available from machine tabulations and computations made during the present winter will be analyzed and a progress report will be prepared.

BOTANNICAL STUDIES

Arboretum: Planting stock of twenty species has been ordered from Forest Service nurseries for installing this number of new blocks in the arboretum this spring. Blocks are from one-fourth to one acre in size. For experimental plantations and for blank areas; an additional 35 acres are scheduled for planting at this time. Altogether, about 50,000 transplants have been ordered for all purposes.

Racial Varities: Twenty--two small plantation plots of ponderosa pine from various localities throughout western United States are scheduled for half-decade remeasurement. These plots are 20 years old. A progress report will be prepared next winter.

Phenology: Observations by cooperators at 15 stations will be continued. Next winter the records recently compiled for the first five years will be analyzed and a progress report will be prepared.

EXPERIMENTAL FORESTS

The possibility of locating a more accessible experimental forest for the southern part of the white pine type than the proposed Pine Creek area will be investigated. A field examination and conferences with Supervisor Myrick and others may locate an area near Pierce which might be acquired by exchange of stumpage. An effort will be made to find a ponderosa pine area to replace the beetle-riddled Trapper Creek tract. Formal reports for the long established Priest River and Bernice areas will be submitted.

FIRE CONTROL

In the research devoted to measuring the variable factors of fire danger the immediate needs are: (1) To install the 18 new inflammability stations ordered, and to assist all 43 stations in obtaining the most accurate records possible. This will require a large part of Gisborne's and Jemison's time throughout June and July and some time in May and August. (2) To improve the methods of measuring inflammability by continuing the intensive tests that have been under way at the Priest River Branch for the past 10 years. An automatically recording instrument for registering wind

velocity and duff and wood moisture also is urgently needed both at field stations and in the study of physical factors affecting fire danger. The development of such a device will demand some funds and considerable time. (3) Continue the collection of data in the study of lightning storms. (4) Commence the compilation of data pertaining to fire behavior by timber and fuel types which was partially assembled in the course of the analysis of the 12,000 fire reports. From three to five months' time will be needed for this work which is fundamental to the most efficient planning of fire control facilities.

Fire control placement planning will be continued with special emphasis devoted to (1) the best method of mapping fuel type, (2) the extent to which the air transparency studies of the Pacific Northwest and California Forest Experiment Stations are applicable to conditions in this Region, and (3) a study of best methods of determining the values of destructible resources especially as applied to the so-called "back country."

FOREST PRODUCTS

LOGGING AND MILLING

No new field projects in Forest Products are contemplated until the data already collected are analyzed and the results made available by publication.

The studies initiated on the holdings of the Anaconda Copper Mining Company and Ohio Match Company will be carried to completion. Results will be made available on all phases of the study during the year through publication of a trade journal article and of a bulletin in cooperation with the University of Montana School of Forestry. Lumbermen in the ponderosa pine region are showing a keener interest in selective logging than ever before. Constantly increasing carrying charges accumulating since 1900 to 1905, when the larger operators acquired their holdings, are exerting a powerful influence for a rapid liquidation of virgin timber holdings. Economic selective cutting offers the timber owner a more rapid means of liquidating his holdings and at the same time automatically inaugurates a rudimentary form of forestry. At the present time the Anaconda Copper Mining Company owns approximately 4½ billion feet of timber in western Montana. As fast as the results become available from our recent studies, they are being furnished them.

WOODS AND MILL UTILIZATION

No special program of work is planned under this project other than incidental time required for inquiries from various agencies concerning woods and mill utilization in this region.

WOOD REQUIREMENTS

The sampling of cities to secure representative data on urban building construction for this region will be continued. As stated in the working plan from Washington, number of samples and selection of communities to be sampled can best be made as the work progresses. After completing Missoula and Spokane, the two principal cities which we plan to cover are Butte and Great Falls, Montana. In order to determine trends and check

information obtained by questionnaires, some data will be collected in a number of the smaller Idaho and Montana cities. During Fiscal Year 1934 it is estimated that Whitney will spend approximately one half of his time on this project.

WOOD PRESERVATION

Collection of service records for treated and untreated experimental timbers will be continued. Four tests for inspection by Whitney and four to be examined by Forest Supervisors will be covered by reports.

FOREST SURVEY

The need for the rapid completion of the Forest Survey in this Region is very apparent from facts here presented. In preparing a recent report, the Inland Empire region was divided into six units or working circles, and the sustained annual yield computed for each. Estimates based on the best available information were presented in two ways; first, the total volume of saw timber in all ownerships regardless of location, species, or accessibility; and, second, the timber in Zone One, which is defined as areas which could be logged without a fundamental change in lumber prices as they have existed in the past. Based on the past average mill operations, the Zone One timber in the three north Idaho-northeastern Washington units would be exhausted in 19, 28, and 38 years, respectively. In order to establish stable lumbering communities based on a sustained yield management plan, a number of the present mills would have to be eliminated and the producing capacity of the remainder materially reduced. The operating life of the 16 existing lumber companies in north Idaho and northeastern Washington is relatively short, figured on the basis of their own individual holdings. Most of these companies would cut out their present holdings in less than ten years, and only one can operate for more than twenty years. This is a very unstable condition and accurate information is needed on the total available supply in all ownerships and its location in relation to the established lumbering communities.

The situation in western Montana is somewhat more favorable. The best available information indicates that the three units tentatively set up in the report have a sustained yield capacity capable of maintaining the present mills indefinitely. One unit is capable of increased production. Accurate information such as the Forest Survey will provide is essential in the immediate future in order to maintain the present condition and to stabilize the lumbering communities.

Every community in western Montana, northern Idaho, and eastern Washington is dependent on the timber industry for its well being. To the largest majority the timber industry means existence. At least 90% of the timbered area in this Region is suitable for timber production only. Included in this area are some of the best timber producing lands in the United States, particularly for white pine, ponderosa pine, and cedar. Private companies can not and will not carry the burden of taxes plus protection from fire and disease which is necessary to bring cutover lands in the Region through to a second crop, particularly without sound information as to what they may expect from these stands in the future. In fact, the time has come when all agencies concerned, the State, counties, lumber companies, individual communities and the Federal Government must make

adequate plans for the future of the Region. The Forest Survey will supply the basic information needed for such plans. It will supply an inventory of the present mature and immature stands by species, with growth and yield figures for them. It will classify the timber producing ability of all of the land in the Region. Non-producing areas, and areas of low productive value will be segregated. Lands more valuable for agriculture than timber will be separated. The entire Region will be zoned for marketability of the timber produced. A thorough economic study of the Region will be made so that all of the basic information may be welded into a practical plan for handling the lands in question. Without prompt action based on reliable basic information, the best timber producing lands in Region 1, which lie outside the National Forests, will largely become non-productive through lack of protection from fire, insects, and disease.

Added to the real need for early availability of the facts to be obtained through the Survey is the need for accomplishing the work as efficiently as possible. Since the Survey has been started in the Region, per acre costs have been high. The necessary overhead which has been set up can handle many times the field organization which the money now available permits. Added funds, which would all go into productive field work, will increase the efficiency of the work in direct proportion to the amount received.

The work to be accomplished with present finances will be limited to:

1. Completion of the field mapping on approximately 900,000 acres. This program will complete the mapping in Benewah inside and outside the National Forest. It will complete Kootenai, Shoshone, and a part of either Bonner or Pend Oreille Counties outside of the Forest. Twenty-five man months are planned for on this activity.

2. Complete the collection of timber estimates in northern Idaho and Pend Oreille County, Washington, for a total of approximately 500,000 acres, divided among 12 sources of information.

3. Check cruise approximately 200 forties in Shoshone and Kootenai Counties to complete the adjustment cruising in these two.

4. Trace types and compile and adjust timber estimates for the area covered during the field season. It is estimated that this will require six man months of office work.

5. Prepare bases and overlays for 1934 field season - one month.

6. Prepare work plans for bringing National Forest information to the Survey standard. This will require study of individual Forest data and the drafting of a general plan with sub-plans for the various Forests - 3 man months.

7. Preparatory work for eastern Washington and western Montana, including the assembly and preparation of maps for field use, and a general survey of the available information. This will require 2 man months.

RANGE RESEARCH

Reduced costs of range cattle production up to $2.40 per head on summer range and an as yet indefinite additional amount for wintering; greater stability for the industry and better conservation and use of soil and water resources are promised by preliminary data from the range utilization and carrying capacity study initiated at Miles City in 1932. Continuation of this project is necessary to weigh numerous variables that affect financial returns to the producer on one hand, and to provide on the other basic data on the proper size for an economic ranch unit, the correct utilization practice and balance between range and crop land, all of which are essential before land utilization in this semi-arid pastoral empire can be placed on a stable foundation.

Wind and water erosion on plowed and abandoned range lands will go from bad to worse until nature's healing process is aided by reseeding to some of the forage species that give promise of stopping this waste of top soil, forage and water resources and change these lands into an asset rather than a community, state, and national liability as at present. Immense enrichment of American agriculture that followed introduction and adoption into farm practice of such plants as alfalfa, timothy and Bermuda grass, to mention but three of a long list, offers an indication of possible benefits from a similar program adopted to range lands. The correct niche that various promising species already successfully introduced should fill in range management practice should be more aggressively investigated in this Region.

EXPERIMENT STATION PERSONNEL

Lyle F. Watts . . . . . Director

Forest Management

R. H. Weidman	Sr. Silviculturist	Silviculture
I. T. Haig	Assoc. "	
H. T. Gisborne	Silviculturist	Fire Research
L. G. Hornby	Reg. For. Inspector	
G. M. Jemison	Jr. Forester	
J. B. Thompson	Jr. Forester, Priest River Branch Sta.	

Ranch Research

L. C. Hurtt	Assoc. Range Examiner
Fred H. Kennedy	Jr. " "

Forest Products

M. I. Bradner	Sr. Forester
I. V. Anderson	Assoc. "
C. N. Whitney	Asst. "

Forest Survey

M. I. Bradner	Sr. Forester
G. M. DeJarnette	Asst. "

Clerical

M. J. Pershina	Chief Clerk
L. J. Hinton	Clerk-Stenographer
Pauline Delatour	Jr. Clerk-Stenographer

Regional Assignees

W. I. White	Fire Research
H. R. Richards	

EXPENDITURES F.Y. 1933
(Estimated to 6-30-33)

Lines of Work	Research Funds	Regional Contribution	Census & Coop. Funds
Forest Management		$8165	$175.51
Botany B-1	$ 1428.05		
Forestation			
Management			
M-1	10213.25		
MT-1			
Selective Logging	174.03		
Mensuration			
ME-1	688.95		
ME-2	1153.60		
ME-3	1164.12		
Protection			
Pf-1	9011.49	1350	
Pf-2	7284.11		
Copeland Report	3182.40		
Total	34300.00	9515	175.51
Range Investigations			
Management			
Short Grass Ranges	8719.02	2000	
Public Domain Report	519.24		
Copeland Report	61.74		
Total	9300.00	2000	
Forest Economics			
Forest Survey - Idaho	14257.25		
Copeland Report	366.14		
Total	14623.39		
Forest Products			
Logging & Milling Studies	6160.09	1640	
Wood Preservation	823.25		
Species Utilization	500.00		
Woods & Mill Utilization	654.10		
Statistics	4035.93	60	700.00
Special studies	1052.51		
Survey-Requirement Phase	861.19		
Copeland Report	22.93		
Total	14110.00	1700	700.00
GRAND TOTAL	$72333.39	$13215	$875.51

Form No. 1

RESEARCH PROJECT ALLOTMENT SHEET

Northern Rocky Mountain Forest & Range Experiment Station

Fiscal Year 1934

Sub-Appropriations and Projects	Research Allotment	Region Contributions	Cooperative Funds			
			Other Bureaus	State	County	Other
			Census			
Forest Management		925				
B-1 Botany	1519	900				
M-1 Management White Pine	10310					
M-2 Management Pond. Pine	346					
Mt-1 Thinning. White Pine	577					
ME-1 Mensuration " "	1155					
ME-2 Mensuration Larch-Fir	231					
ME-3 Mensuration Pond. Pine	462					
Pf-1 Attack	6629	1000				
Pf-2 Behavior	10491					
Total	31720	2825				
Range Investigations						
Mgt. Short Grass Ranges	7200					
Forest Economics						
Forest Survey - Idaho	11613					
- Washington	2050					
Total	13663					
Forest Products						
Logging & Milling Studies	5805	400				
Woods & Mill Utilization	694					
Wood Preservation	347					
Species Utilization						
Statistics	4545		950			
Special Studies	1735					
Total	13126	400	950			

Form No. 3

ESTIMATED DISTRIBUTION OF DIRECT
AND OVERHEAD EXPENDITURES

Northern Rocky Mountain Forest & Range Experiment Station

Fiscal Year 1934

Sub-Appropriation	Direct	Overhead	Total
	Dollars	Dollars	Dollars
Forest Management	27,363	4,357	31,720
Range Investigations	6,224	976	7,200
Forest Products	11,349	1,777	13,126
Forest Survey	11,886	1,777	13,663
Forest Economics			
Erosion & Streamflow			
Total	56,822	8,887	65,709
Per Cent of Total	86.5	13.5	100

Overhead expenses are prorated uniformly on the basis of the total allotment.

PUBLICATIONS

PUBLISHED SINCE LAST REPORT

1. Second Growth Yield, Stand and Volume Tables for the Western White Pine Type. I. T. Haig. Tech. Bul. #323. October, 1932.

2. Comparative Timber Yields. I. T. Haig. Journal of Forestry. May, 1932.

3. Note on Premature Seed Germination During Natural Storage in Duff. I. T. Haig. Ecology. July, 1932.

4. Climatological Summary for the Priest River Forest Experiment Station. G. M. Jemison. Mimeographed.

5. Meteorological Conditions Affecting the Freeman Lake Fire. G. M. Jemison. Monthly Weather Review. January, 1932.

6. Volume Table for Ponderosa Pine. I. V. Anderson. West Coast Lumberman.

7. Does Fire Protection in Ponderosa Pine Pay? I. V. Anderson. Forest Worker and Montana Kaimin.

8. Woods and Mill Utilization in Northern Idaho and Western Montana. I. V. Anderson. Journal of Forestry. October, 1932.

9. The Forest Problem in Western Montana. I. V. Anderson. Journal of Forestry. January, 1933.

10. Properties of Western Larch and Their Relation to Uses of Wood. R. P. A. Johnson and M. Bradner. Tech. Bul. #285.

11. Public Domain and Other Federal Forest Land. Lyle F. Watts. Copeland Report.

12. Reforestation of Barren and Unproductive Land. Lyle F. Watts. (Co-Author.) Copeland Report.

13. A Watershed Protection Program. Lyle F. Watts. (Co-Author.) Copeland Report.

SUBMITTED FOR PUBLICATION

1. An Analysis of Log Production in the Inland Empire Region. Bradner, Girard, Fullaway and Klobucher. Tech. Bulletin.

2. Forest Fire Control Objectives and Practices in the Northern Rocky Mountain Region. L. G. Hornby and H. T. Gisborne. Manuscript to Regional Office. February, 1933.

3. Lightning and Forest Fires. H. T. Gisborne. Pulp and Paper of Canada.

4. The Wood Cylinder Method of Measuring Forest Inflammability. H. T. Gisborne. Journal of Forestry.

5. Timber Growing and Logging Practice in Ponderosa Pine in the Northwest. R. H. Weidman. U.S.D.A. Bulletin.

6. Progress of Research in Silviculture in the Inland Empire. R. H. Weidman. Northwest Science.

7. Some Climatic Effects on Forest Stands and Forest Types. R. H. Weidman. Northwest Science.

8. Growth and Yield of Western White Pine. I. T. Haig. Timberman.

9. Recovery, Growth and Treatment of Understory Hemlock Released by Logging in the Western White Pine Type. I. T. Haig. Journal of Forestry.

10. Conifers of the Northern Rocky Mountains. J. A. Larsen. U.S.D.A. Bulletin.

IN PREPARATION OR PROPOSED FOR F.Y. 1934

1. Selective Logging in Western Montana with Special Reference to Economic Selection. I. V. Anderson and Cooperators. University of Montana Bulletin.

2. Selective Logging in the Ponderosa Pine Type of the Inland Empire. I. V. Anderson and M. Bradner. Dept. Bulletin.

3. Conversion Value of Idaho White Pine Commercial Lumber vs. Match Plank. I. V. Anderson. Trade Journal.

4. Possibilities of Selective Cutting in Larch-Douglas Fir Stands of Western Montana. I. V. Anderson. Trade Journal.

5. The Economic Range Livestock Unit for the Northern Great Plains. L. C. Hurtt. Trade Journal.

6. A Method of Rating Areas in Relation to Fire Danger. L. G. Hornby. Journal of Forestry.

7. Methods of Fire Control Placement Planning. L. G. Hornby. Article.

8. Lessening the Guesstimating in Forest Fire Control. H. T. Gisborne. Article.

9. The Northern Rocky Mountain Scale for Wind Velocity Determination. G. M. Jemison. Monthly Weather Review.

10. Sources of Regeneration Following Fires in the Western White Pine Forest. R. H. Weidman. Journal of Forestry.

11. Results of Thinning Experiments in the Western White Pine Type. R. H. Weidman. Progress Report.

12. Some Aspects of Succession in the Western Yellow Pine Forest. R. H. Weidman. Ecology.

13. Results of Five Years Phenological Observations in the Northern Rocky Mountain Region. R. H. Weidman. Progress Report.

14. A Silvicultural Study of Western White Pine. R. H. Weidman and I. T. Haig. U S.D.A. Bulletin.

15. Reproduction and Residual Growth on Cut-Over Areas in the Western White Pine Type. I. T. Haig. Final Report.

16. Factors Affecting Early Seedling Survival in the Western White Pine Forest. I. T. Haig. Doctorate Thesis.

17. Effect of Composition on Yield in Western White Pine Stands. I. T. Haig. Article.

18. Effect of Composition, Site, and Other Factors on Tree Volume in Western White Pine Stands. I. T. Haig. Article.